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800 SERIES AND ERICOFON TELEPHONES.

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PREVIOUSLY MS 021

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1. INTRODUCTION.

1.1 The 800 series telephone is the standard A.P.O. telephone for general use in Automatic and C.B. areas. It is anticipated that it will gradually replace the existing telephones of the 300 and 400 series.

1.2 It is of wholly Australian manufacture. Modern printed circuit techniques are used, together with miniaturisation of many components, making the instrument slightly smaller in physical size and much lighter in weight than any of its predecessors. Its case and handset are of moulded thermo-plastic material which combines light weight with high impact strength and a pleasant appearance.

The 800 series telephones have several new features which are a distinct breakaway from previous convention. Some of these new features include the bell, the gravity switch, printed circuitry, quick-connect terminations, and the terminal block, among others. The details of some of these features are discussed in the following text.

Differentiation between types is achieved by the use of a three-figure code (i.e. 801, 811 etc.) which effectively avoids the necessity of adding such letter suffixes as 'AT' and 'CBT' etc. for example, the 801 is catalogued as an automatic table handset type, and the 811 is the parallel of the existing CBT type. The addition of a fourth digit indicates a special feature. For example:- an 8011 telephone is an auto table handset fitted with a recall push button; an 8201 is a two line telephone of the 801 type with two miniature plunger-type keys and a push-button, and replaces the telephone and Hold-and-call-back arrangement previously used.

1.3 Fig. 1 shows the face view of a Telephone 801. Each instrument in the 800 series is available in any of five (5) colours:-

Light Ivory,
Mist Grey,
Fern Green,
Topaz Yellow, and
Lacquer Red.

Apart from the dial, all parts are colour-matched, including the line and handset cords.

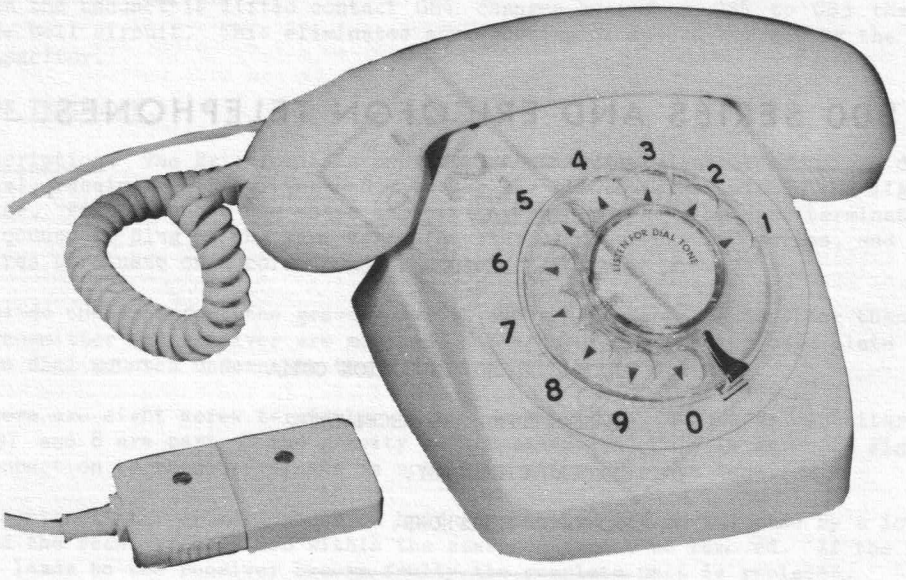


FIG. 1. FACE VIEW OF TELEPHONE 801.

2. SPECIAL FEATURES.

2.1 The polarized bell and its assembly. The single coil polarised bell operates on a minimum current of only 4mA, and rings satisfactorily at frequencies from 16 to 50c/s.

Adjustment of the bell loudness (or volume) is provided by means of a control cam which the subscriber can adjust at will, and which restricts the travel of the bell hammer so that the sound is variable from a two-gong strident ring through to a soft buzzing sound made only by the movement of the armature.

The two similar sized gongs, one a high tone and one a low tone give a clear and harmonious ring.

The bell assembly is shown in Fig. 2, where the muting control action is maximum, giving only a buzzing signal. In the inset of Fig. 2 the control is in the minimum muting position, and the bell will ring.

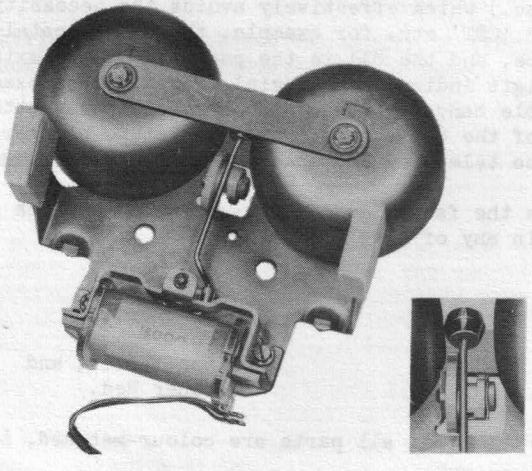


FIG. 2. POLARISED BELL ASSEMBLY.

The polarising permanent magnet is made of ferrite, and is mounted inside the single coil. The permanent magnet flux has two distinct and parallel paths each of which contains two air-gaps in series - a "working" air-gap, and an auxiliary one. This is shown in Fig. 3, where the permanent magnet flux is shown by unbroken lines.

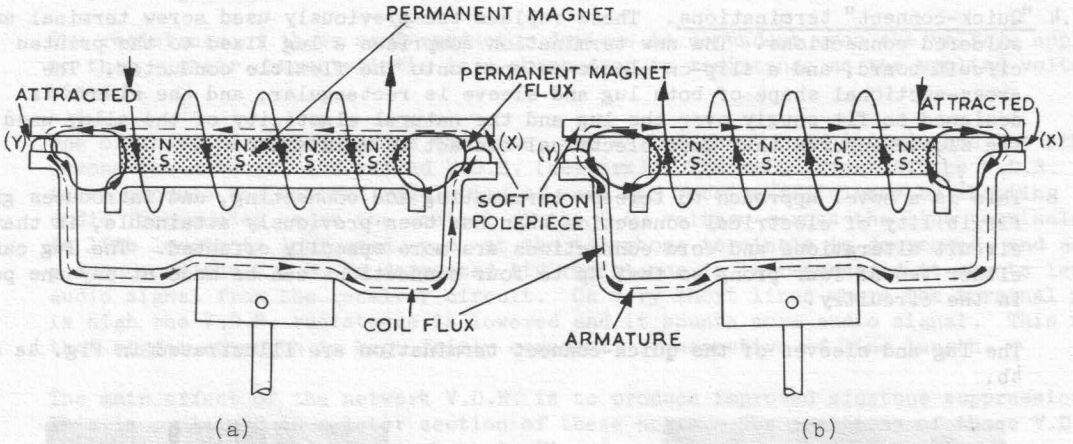


FIG. 3. MAGNETIC CIRCUIT OF POLARISED BELL.

The electromagnetic flux produced by the alternating ringing current in the coil passes through the two working air-gaps in series, the armature, and the soft iron pole piece. This is shown by the dotted lines in Fig. 3.

For one half cycle of ringing current the coil flux opposes the permanent magnet flux at one end, but aids it at the other end. Thus in Fig. 3a the flux is reduced at X and strengthened at Y resulting in the armature being attracted at Y, as it is shown in Fig. 3a. On the other half cycle the permanent magnet flux is still in the same direction, but the coil flux has reversed, so that in this case flux is weakened at Y and strengthened at X, and attraction occurs at the end marked X, as shown in Fig. 3b. Thus the armature moves twice per cycle, so that the attached hammer oscillates back and forth in synchronism with the ringing frequency.

Adjustment of the working air-gap is obtained by moving the coil and magnet assembly nearer to or further from the armature as required. These adjustments are made with the aid of a special jig, and it is laid down that bell adjustments of this nature are not done in the field.

2.2 The Gravity Switch. This is the term now used for what was previously known as the switch hook or cradle switch. In the 800 series telephones, the gravity switch is miniaturised and includes 2 make and 2 changeover contacts (the make contacts make when the handset is lifted), though only one make and one changeover unit are used in the normal electrical circuit. A transparent clip-on cover is provided to minimise contact faults due to dust. The contact springs and contacts are readily accessible for cleaning, though this should, under normal conditions, be not often required, in view of the spark-quenching circuitry employed. This is described in para. 6.2 of these notes.

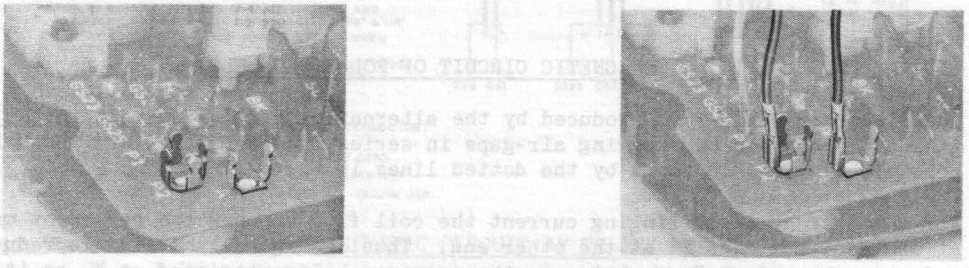
2.3 Printed Circuitry. The printed circuit board used in the 800 series telephones is make of resin-bonded fibre-glass. During manufacture the board is first laminated on one side with copper which is then partly etched from the surface with acid. The copper which remains forms the basis for the solder connecting leads between components. These leads are insulated from each other by separation on the surface of the fibre-glass. Special copper "lands" are left after the etching process to form solder anchoring points for the induction coil which is the heaviest component on the board. The other components are secured to the board solely by dip soldering their electrical connecting tags or wires to the printed circuit conductors after inserting them through the holes drilled in the board.

Compactness is achieved, in that three bulky components (Capacitor unit, Induction coil and Gravity Switch) are mounted on the board together with over twenty terminals, radio type resistors and VDRs., yet the use of "quick-connect" studs and sleeves permits ample accessibility to all components and connections.

2.4 "Quick-connect" terminations. These replace the previously used screw terminal and soldered connections. The new termination comprises a lug fixed to the printed circuit board, and a slip-on sleeve crimped onto the flexible conductor. The cross-sectional shape of both lug and sleeve is rectangular, and the sleeve is designed to fit snugly over the lug and the natural elasticity of the alloy used for the sleeve ensures that good electrical contact is maintained.

This is a novel approach to telecom terminating and connecting, and introduces greater flexibility of electrical connection than has been previously attainable, in that circuit alterations and cord connections are more speedily effected. The lug can be either two of four prong so that up to four connections can be made at any one point in the circuitry.

The lug and sleeves of the quick-connect termination are illustrated in Fig. 4a and 4b.



(a) Four and Two lug terminals. (b) Connecting sleeves.

FIG. 4. "QUICK-CONNECT" TERMINATIONS.

2.5 Line Connection. Connection of the 800 series telephone to the permanent wiring is effected by means of a plug and socket type connector, which can serve either as a terminal block for a fixed telephone or as a plug and socket connection in the case of a portable telephone service. This latter is the standard procedure, unless the subscriber requests otherwise.

The plug has an orienting lug on it to ensure that it can be inserted in only the correct way. Provision is made for up to 6 point connection and the contact springs are clearly designated in both plug and socket. The combination should be side mounted wherever possible to prevent foreign objects falling into the socket when the plug is removed for any reason. Fig. 5 shows the construction of the plug and socket.

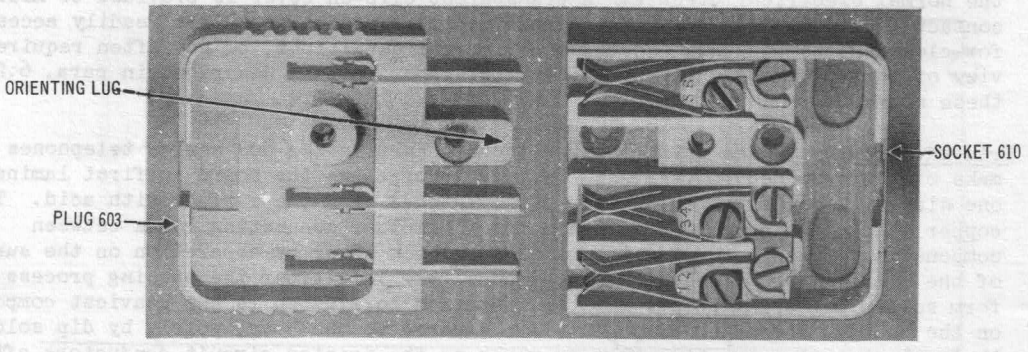


FIG. 5. CONSTRUCTION OF PLUG 603 AND SOCKET 610.

2.6 V.D.Rs. Use is made of non-linear voltage dependent resistors, (known by the trade name of "Varistors" but more correctly as V.D.Rs.) to control the current through the transmitter and receiver over all the lengths of line likely to be encountered. This dispenses with the necessity to provide a non-inductive resistance as a series component on short line, as is done with the 400 series telephones at present.

The resistance of these semi-conductor devices is dependent upon the voltage applied to them - their characteristic is a sharp drop in resistance as the applied voltage rises.

One of these is placed across the line, and called the V.D.R. (line), and the other across the network, and called V.D.R. (network). The main affect of the V.D.R. (line) is to produce the desired regulation of send and receive efficiency by shunting audio frequencies under the control of the D.C. voltage across the line terminals. As line length is increased, p.d. at the telephone terminals is decreased, and as the p.d. across the V.D.R. is decreased its resistance is increased and it shunts less audio signal from the receiver circuit. On very short lines where the terminal p.d. is high the V.D.R. resistance is lowered and it shunts more audio signal. This means that signal strength is kept fairly constant, irrespective of line length.

The main effect of the network V.D.R. is to produce improved sidetone suppression. This is explained in a later section of these notes. The positions of these V.D.Rs. in the telephone circuit are shown in Fig. 8.

3. ANTI-SIDETONE INDUCTION COIL.

3.1 The induction coil has 3 inductive windings, the D.C. resistance and number of turns of which are:-

22Ω winding of 900 turns between terminals 1 and 2
8Ω winding of 540 turns between terminals 2 and 3
6Ω winding of 315 turns between terminals 3 and 4

Terminals 5 and 6 are spare, and are provided to allow for possible circuit modifications.

3.2 All the windings are on the centre limb of a shell type core which is made up of two laminated E sections clamped together by metal spring clips. These metal clips are provided with solder lugs which are used solely to provide secure mechanical anchorage of the comparatively heavy induction coil to the printed board. Fig. 6 is an illustration of the complete coil and Fig. 7 shows the schematic winding arrangement.

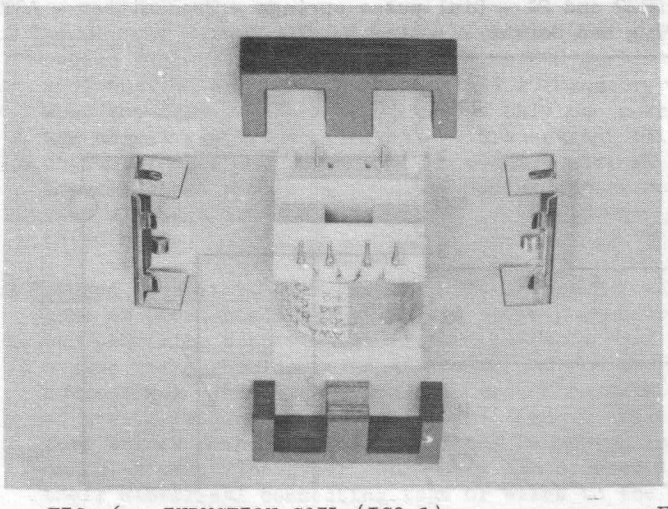


FIG. 6. INDUCTION COIL (ICO-1).

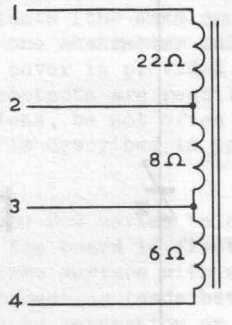


FIG. 7. SCHEMATIC CIRCUIT.

4. CIRCUIT.

4.1 The schematic circuit for an 801 telephone is shown in Fig. 8 (CE-11021 - Sheet 1).

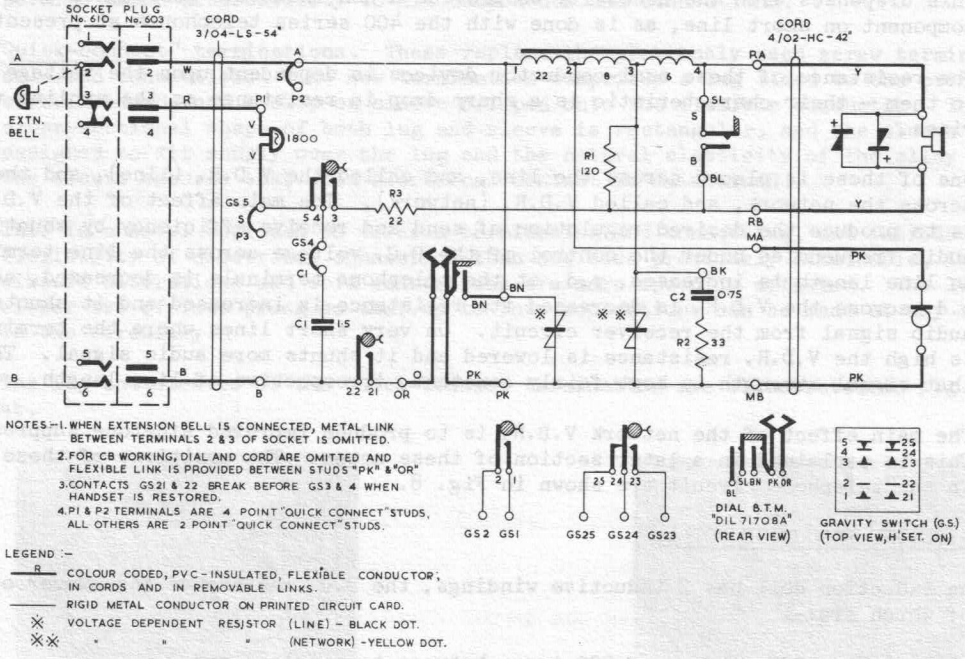

SOCKET No. 610
PLUG No. 603
CORD 3/04-LS-54
CORD 4/02-HC-42
EXTN. BELL
1800
R1 120
R2 33
R3 22
C1 1·5
C2 0·75
NOTES:-1. WHEN EXTENSION BELL IS CONNECTED, METAL LINK BETWEEN TERMINALS 2 & 3 OF SOCKET IS OMITTED.
2. FOR CB WORKING, DIAL AND CORD ARE OMITTED AND FLEXIBLE LINK IS PROVIDED BETWEEN STUDS "PK" & "OR"
3. CONTACTS GS21 & 22 BREAK BEFORE GS3 & 4 WHEN HANDSET IS RESTORED.
4. P1 & P2 TERMINALS ARE 4 POINT "QUICK CONNECT" STUDS, ALL OTHERS ARE 2 POINT "QUICK CONNECT" STUDS.
GS2 GS1
GS25 GS24 GS23
DIAL S.T.M. "DIL 7170BA" (REAR VIEW)
GRAVITY SWITCH (GS) (TOP VIEW, H'SET. ON)
LEGEND :-
COLOUR CODED, PVC-INSULATED, FLEXIBLE CONDUCTOR; IN CORDS AND IN REMOVABLE LINKS.
RIGID METAL CONDUCTOR ON PRINTED CIRCUIT CARD.
VOLTAGE DEPENDENT RESISTOR (LINE) - BLACK DOT.
(NETWORK) - YELLOW DOT.

FIG. 8. SCHEMATIC CIRCUIT OF TELEPHONE 801.

The path for incoming ring on one half cycle is:-

Line A (L1) - Socket 2 and 3 (strapped) - Plug 3 - P1 terminal 1800Ω Bell - GS5 and 4 - C1 (1.5μF) - B terminal - Plug and Socket 6 - Line B (L2). The other half cycle follows the same path in the reverse direction.

5. TRANSMITTING AND RECEIVING.

5.1 Transmission. When the handset is lifted the exchange equipment is looped and the D.C. circuit through the instrument is as follows. Line B (-ve Battery leg) - Plug and socket 6 - B terminal - GS22 and 21 - Dial pulse springs - Transmitter - ASTIC 22Ω winding - A Terminal - Plug and Socket 2 - Line A.

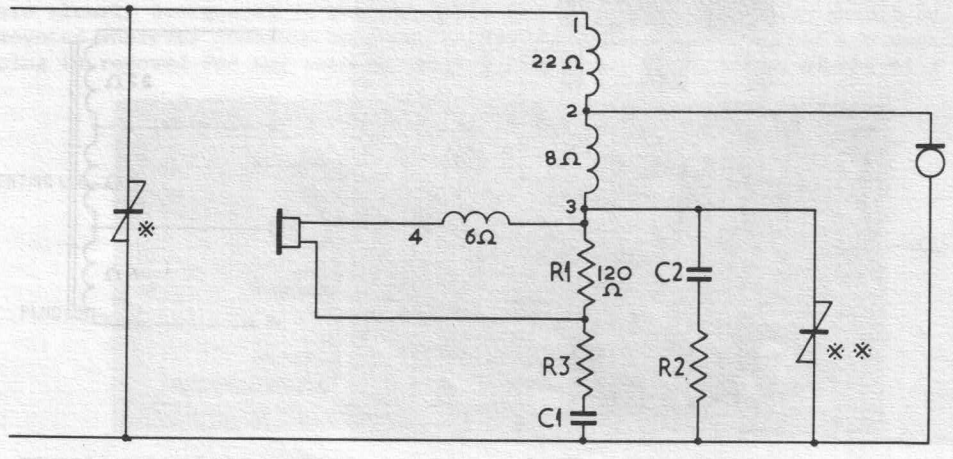


FIG. 9. SIMPLIFIED SPEAKING CIRCUIT.

The A.C. component of the speech from the transmitter divides at ASTIC terminal 2, part flowing via the 8Ω winding and network, and part to line via the 22Ω winding. The changing current in the 8Ω winding induces an e.m.f. in the 22Ω winding in such a direction that additional current flows to assist and thus increase the line current. This changing current in the 8Ω winding also induces an e.m.f. in the 6Ω winding, the direction of which is opposite to the p.d. developed across the 120Ω NIR in the network.

This induced e.m.f. and the p.d. over the 120Ω NIR are in opposition, so that current in the receiver (sidetone) is reduced.

The network V.D.R. improves sidetone suppression by shunting the network to such a degree that the impedance of the network and its V.D.R. is balanced against the impedance of the line and its V.D.R. The effects of this are an improvement mainly evident on short loops.

5.2 Received Speech. A.C. incoming signal from the remote telephone flows through the 22Ω winding and transmitter - a voltage is induced in the 6 ohm winding and current flows in the 120Ω and receiver circuit. Any current flowing in the other winding assists that in the receiver circuit.

The use of V.D.Rs. also provides an additional benefit, as their combined D.C. shunting effect reduces current through the transmitter on short loops, this is instrumental in reducing "frying" by the carbon granules, and increases the service life of the transmitter.

6. SPECIAL CIRCUITRY.

6.1 Fig. 10a shows the main elements involved in the dialling circuit.

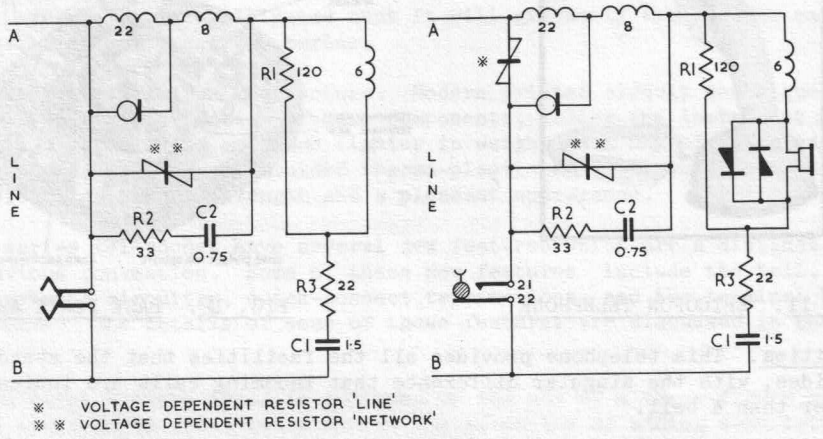


FIG. 10. DIAL PULSING CIRCUIT AND SPARK QUENCH.

When the dial off-normal springs make, one set places the dial directly across the A and B sides of the circuit, and the other set places a short circuit across the receiver circuit. Spark quenching for the dial contacts is provided by resistor R3 (22 ohms) and capacitor C1 (1.5μF).

6.2 Spark quenching is also applied to the gravity switch springs. In order to achieve this it has been necessary to sequence the contacts GS 3 and 4 to break after contacts GS 21 and 22, as the handset is restored (Fig. 10b). The sequencing of the gravity switch in this telephone is therefore of opposite timing to that provided in the 400 telephone. This is possible due to the provision of the shock absorbing rectifiers across the receiver which make the sequencing for click suppression unnecessary.

These shock absorbing rectifiers are connected in opposite directions across the receiver. Refer to Fig. 10b. Any surge of voltage that would be developed across the receiver is suppressed by one of these two diodes. Their action is to shunt from the receiver any high voltage surges.

6.3 When the handset is lifted contact GS4 changes over from GS5 to GS3 thereby opening the bell circuit. This eliminates any shunting of speech current by the bell and capacitor.

7. ERICOFON TELEPHONE.

7.1 Description. The Ericofon is a one piece desk model telephone of unique design. The dial, receiver, transmitter and a buzzer are all contained within the light weight case. Fig. 11 shows the shape of this telephone. The line cord terminates on a 6 connector plug of the same design as that used for the 800 series, and the line wires terminate on a corresponding socket.

Inside the Ericofon, the gravity switch and all the components other than the transmitter and receiver are mounted on the upper side of the base plate which holds the dial mounted underneath the gravity switch.

There are eight screw terminals - 1 to 6 are part of the buzzer capacitor unit, and AS7 and 8 are part of the gravity switch assembly. This is shown in Fig. 12 Connection to these terminals is solely by means of spade tags.

The transmitter or microphone is held in position inside the case by a locking ring, and the receiver is glued within the case and cannot be removed. If the receiver or leads to the receiver become faulty the complete unit is replaced.

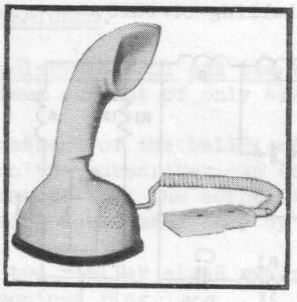


FIG. 11. ERICOFON TELEPHONE.

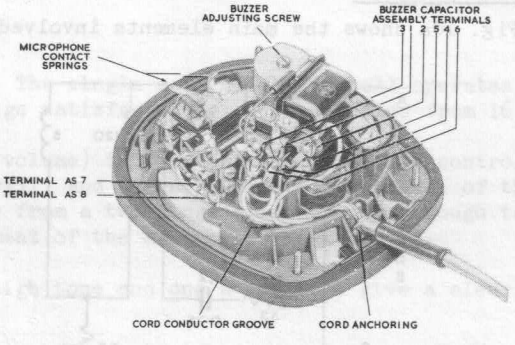


FIG. 12. BASE PLATE ASSEMBLY.

7.2 Facilities. This telephone provides all the facilities that the standard telephone provides, with the singular difference that incoming calls are indicated by a buzzer rather than a bell.

Their installation is restricted to additional telephones on simple services, and as alternative choice telephones for use on P.M.B.X. extensions.

END.